The transformation of Chinese agriculture

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Introduction

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This serves as a clue that growth in Chinese agriculture has been significant, and that it has had dramatic implications for the welfare of Chinese households – particularly rural households.

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- However, average level of consumption for households (in terms of caloric intake) remained low, particularly in rural areas.
- In addition, China witnessed a dramatic famine during 1959-61 (during the Great Leap Forward); more than 30 million people died, rendering this the worst famine in history.
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Introduction

Background

This unit's research papers

Reallocations and investment

Grain quota and transitions out of agriculture

Summary statistics: Agriculture under socialism


<table>
<thead>
<tr>
<th>Year</th>
<th>Grain Sown area (million hectares)</th>
<th>Grain Output (million tons)</th>
<th>Grain Yield (ton/ha)</th>
<th>Cotton Sown area (1,000 hectares)</th>
<th>Cotton Output (1,000 tons)</th>
<th>Cotton Yield (ton/ha)</th>
<th>Structure of cropping (grain-sown area/total sown area)</th>
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<tbody>
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<td>1950</td>
<td>114.41</td>
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<td>1.16</td>
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<tr>
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<td>2,277</td>
<td>0.458</td>
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<tr>
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<td>250.14</td>
<td>2.07</td>
<td>4,924</td>
<td>2,105</td>
<td>0.428</td>
<td>83</td>
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<tr>
<td>1972</td>
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<td>240.47</td>
<td>1.98</td>
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<td>1,958</td>
<td>0.398</td>
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<tr>
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<td>270.16</td>
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<td>2,562</td>
<td>0.518</td>
<td>82</td>
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<tr>
<td>1974</td>
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<td>275.28</td>
<td>2.27</td>
<td>5,014</td>
<td>2,461</td>
<td>0.488</td>
<td>81</td>
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<tr>
<td>1975</td>
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<td>284.51</td>
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<td>2,381</td>
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<tr>
<td>1976</td>
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<td>286.31</td>
<td>2.37</td>
<td>4,929</td>
<td>2,053</td>
<td>0.420</td>
<td>81</td>
</tr>
<tr>
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<td>282.73</td>
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<td>4,845</td>
<td>2,049</td>
<td>0.420</td>
<td>81</td>
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<tr>
<td>1978</td>
<td>120.59</td>
<td>304.77</td>
<td>2.53</td>
<td>4,866</td>
<td>2,167</td>
<td>0.443</td>
<td>80</td>
</tr>
</tbody>
</table>

Source: Yearbook (various years).
Agricultural institutions in the pre-reform period

➤ Upon seizing power, the CCP first implemented a comprehensive land reform; land was seized from landlords and rich farmers and divided among all rural households.

➤ Quickly, however, this private land ownership system was undercut; farmers were organized into cooperatives, and then into larger communes.

➤ In this system, farmers weren't the residual claimants from production, and decisions were often centralized – both leading to inefficiencies.

➤ Instead, they were paid on the basis of a workpoint system.
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Pricing and marketing of commodities

- Prices for output were fixed by the state, and rarely changed.
- Almost all production was sold to the state at low prices; the state, in turn, sold these staples at low prices to urban households using ration coupons.
- There was a severe shortage of inputs.
- In addition, the hukou registration system tied rural households to their villages, preventing them from migrating.
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Agriculture in the reform period

- Annual growth rates of agriculture increased dramatically in the reform period: to 8.2% annually between 1978 and 1984, and 4% annually between 1985 and 2000.

- In addition, there was extremely rapid growth in cash and other non-grain crops.

- At the same time, rapid growth across other sectors rendered agriculture less and less important in the overall Chinese economy.
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### Summary statistics: Agriculture in the reform period

#### Table 13.3. Annual growth of Chinese agriculture by commodity, 1970–2000

<table>
<thead>
<tr>
<th>Commodity</th>
<th>Pre-reform period</th>
<th>Reform period</th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Agricultural GDP</td>
<td>4.9</td>
<td>8.8</td>
<td>3.8</td>
<td>4.2</td>
</tr>
<tr>
<td>Grain</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Production</td>
<td>2.8</td>
<td>4.7</td>
<td>1.7</td>
<td>0.03</td>
</tr>
<tr>
<td>Sown area</td>
<td>0.0</td>
<td>-1.1</td>
<td>-0.1</td>
<td>-0.14</td>
</tr>
<tr>
<td>Yield</td>
<td>2.8</td>
<td>5.8</td>
<td>1.8</td>
<td>0.17</td>
</tr>
<tr>
<td>Rice</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Production</td>
<td>2.5</td>
<td>4.5</td>
<td>0.6</td>
<td>0.3</td>
</tr>
<tr>
<td>Sown area</td>
<td>0.7</td>
<td>-0.6</td>
<td>-0.6</td>
<td>-0.5</td>
</tr>
<tr>
<td>Yield</td>
<td>1.8</td>
<td>5.1</td>
<td>1.2</td>
<td>0.8</td>
</tr>
<tr>
<td>Wheat</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Production</td>
<td>7.0</td>
<td>8.3</td>
<td>1.9</td>
<td>-0.4</td>
</tr>
<tr>
<td>Sown area</td>
<td>1.7</td>
<td>-0.0</td>
<td>0.1</td>
<td>-1.4</td>
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<tr>
<td>Yield</td>
<td>5.2</td>
<td>8.3</td>
<td>1.8</td>
<td>1.0</td>
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<tr>
<td>Maize</td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>Production</td>
<td>7.4</td>
<td>3.7</td>
<td>4.7</td>
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</tr>
<tr>
<td>Sown area</td>
<td>3.1</td>
<td>-1.6</td>
<td>1.7</td>
<td>0.8</td>
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<tr>
<td>Yield</td>
<td>4.2</td>
<td>5.4</td>
<td>2.9</td>
<td>-0.9</td>
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<tr>
<td>Total (cash crop sown area)</td>
<td>2.4</td>
<td>5.1</td>
<td>2.1</td>
<td>3.5</td>
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<tr>
<td>Cotton</td>
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<tr>
<td>Production</td>
<td>-0.4</td>
<td>19.3</td>
<td>-0.3</td>
<td>-1.9</td>
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<td>Sown area</td>
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<td>6.7</td>
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<tr>
<td>Yield</td>
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<td>11.6</td>
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<td>Edible oil crops</td>
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<td>5.6</td>
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<tr>
<td>Vegetable area</td>
<td>2.4</td>
<td>5.4</td>
<td>6.8</td>
<td>9.5</td>
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<tr>
<td>Fruit</td>
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<tr>
<td>Orchards area</td>
<td>8.1</td>
<td>4.5</td>
<td>10.4</td>
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<tr>
<td>Outputs</td>
<td>6.6</td>
<td>7.2</td>
<td>12.7</td>
<td>8.6</td>
</tr>
<tr>
<td>Meat (pork/beef/poultry)</td>
<td>4.4</td>
<td>9.1</td>
<td>8.8</td>
<td>6.5</td>
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<td>5.0</td>
<td>7.9</td>
<td>13.7</td>
<td>10.2</td>
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</table>

Notes: Values are in percent. Growth rates are computed using the regression method. Growth rates of individual items and groups of commodities are based on production data; sectoral growth rates refer to value added in real terms.

### Summary statistics: Structural change in China’s economy

#### Table 13.6. Structural change in China’s economy, 1970–2000

<table>
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<th></th>
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<td><strong>Share in GDP</strong></td>
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<td>27</td>
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<tr>
<td>Industry</td>
<td>46</td>
<td>49</td>
<td>43</td>
<td>42</td>
<td>49</td>
<td>51</td>
</tr>
<tr>
<td>Services</td>
<td>13</td>
<td>21</td>
<td>29</td>
<td>31</td>
<td>31</td>
<td>33</td>
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<tr>
<td><strong>Share in employment</strong></td>
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<td>Agriculture</td>
<td>81</td>
<td>69</td>
<td>62</td>
<td>60</td>
<td>52</td>
<td>50</td>
</tr>
<tr>
<td>Industry</td>
<td>10</td>
<td>18</td>
<td>21</td>
<td>21</td>
<td>23</td>
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</tr>
<tr>
<td>Services</td>
<td>9</td>
<td>13</td>
<td>17</td>
<td>19</td>
<td>25</td>
<td>27.5</td>
</tr>
</tbody>
</table>

*Note: Values are in percent.*

*Source: Yearbook and Rural Statistics Yearbook (various issues).*
Production and marketing environment

- There have been dramatic changes in the role of government in agricultural and marketing.
- A large majority of sales of grains, oilseeds and fiber, and all sales of horticultural and livestock producers, flow to private traders; the government still purchases around 20-30% of grain at a below-market price.
- With the combination of rising productivity, production of higher-value crops and livestock, higher output prices and the expansion of off-farm work, rural incomes have risen dramatically.
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▶ With the combination of rising productivity, production of higher-value crops and livestock, higher output prices and the expansion of off-farm work, rural incomes have risen dramatically.
## Summary statistics: Increases in rural income

Table 13.9. *Rural income per capita in China, 1980–2001 (real terms, 2000 yuan)*

<table>
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<td>Average</td>
<td>711</td>
<td>1,248</td>
<td>1,305</td>
<td>1,702</td>
<td>2,253</td>
<td>2,347</td>
<td>6</td>
</tr>
<tr>
<td>Bottom decile (poorest)</td>
<td>312</td>
<td>448</td>
<td>442</td>
<td>493</td>
<td>579</td>
<td>578</td>
<td>3</td>
</tr>
<tr>
<td>Top decile (richest)</td>
<td>1,530</td>
<td>2,486</td>
<td>3,253</td>
<td>4,763</td>
<td>6,805</td>
<td>7,159</td>
<td>8</td>
</tr>
</tbody>
</table>

*Source:* Yearbook (various issues).
This unit’s papers

In order to understand the agricultural sector in China better, we will examine two papers.

The first is an older, macro-level paper by Justin Lin that seeks to analyze determinants of growth at the provincial level in the early years of reform.

The second is a newer, micro-level paper written by me that analyzes the impact of insecure property rights on agricultural outcomes at the micro level in more recent years.
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This paper seeks to analyze agricultural growth during the earliest period of reform in China, 1978-1984.

Lin is particularly interested in identifying the contribution of decollectivization, price adjustments and other reforms to China’s agricultural growth.

He uses a production function approach and provincial-level data from 1970 to 1987.
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Primary specification

More specifically, he estimates the following specification.

\[
\ln Y_{it} = \alpha_1 + \alpha_2 \ln Land_{it} + \alpha_3 \ln Labor_{it} + \alpha_4 \ln Capital_{it} + \alpha_5 \ln Fert_{it} \\
+ \alpha_6 HRS_{it} + \alpha_7 MP_{t-1} + \alpha_8 GP_{t} + \alpha_9 NGCA_{it} + \alpha_{10} MCI_{it} \\
+ \alpha_{11} t_t + \sum_{j=12}^{39} \alpha_j D_j + \epsilon_{it}
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These are standard agricultural inputs, plus six other variables: proportion of teams that have changed to household responsibility system (HRS), index of market prices relative to input prices (MP), index of above-quota prices relative to input prices (GP), percentage of sown area in nongrain crops (NGCA), multiple cropping index (MCI), and time trend T.
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Primary specification, cont.

- Lin then uses the results of the production function estimation to estimate how much of the observed growth is attributable to various causes: growth in inputs, institutional reforms, and a productivity residual.

- He also separates this into the earliest years of reform (pre-1984) and subsequent years; they ultimately have very different patterns.
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Discussion questions

- We have already seen some papers employing production functions; thus you should be more comfortable with the methodology.
- This paper uses relatively straightforward specifications; key questions to analyze include the following.
  - What do Lin's key findings suggest about sources of growth in the agricultural sector?
  - What variables does Lin use to capture institutional change?
  - What are the advantages and disadvantages of these variables? Can you propose other measurement strategies?
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Introduction

Lin’s paper analyzes a rapid process of liberalization in the early reform period.

However, China’s rural sector is by no means fully liberalized; in particular, Chinese rural households still live under an arguably somewhat unusual regime of partially collective property rights, and this may have substantial implications for their economic decision-making.

Rural property rights in China were the subject of the primary chapter of my PhD thesis.
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Changing land rights in China

- Land was collectivized in China between 1958 and 1979.
- From 1979 to 1983, the Household Responsibility System was implemented, returning (partial) use rights over land to individual households; title is retained by the village collective.
- There is no private land market; periodic reallocations are primary threat to households’ security of tenure.
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- The stated purpose of reallocations is to promote equity and to accommodate demographic shifts in the absence of a land market.
- Village leaders may also use reallocations to extract rents.
- Literature and prior surveys suggest reallocation entails full swaps of land between households; both households that net gain land and households that net lose land, lose their original plot.
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Assume official chooses whether to hold a reallocation; he perceives benefits $B$, including rent-seeking, increased equity, improved match between households and plots.

There is a transactional cost $T$, larger in areas with higher topographic variability.
Optimizing the choice of reallocation

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Household valuation of reallocation

- In addition, households impose cost $C$ on officials who reallocate.
  - Tenure insecurity induced by a reallocation generates a decline in agricultural investments with medium-term returns, and thus a decline in output.
  - $C$ assumed to be increasing in the difference in output induced by a reallocation: households that stand to lose more, bargain more aggressively against reallocation.
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Comparative statics

- The official will reallocate if \( B > T + C \).
- Reallocations should be less common given a larger predicted decline in output, and less common given rugged topography.
- In addition, the official who chooses to conduct a reallocation then faces a second margin of optimization.
  - How to adjust landholdings, and for which households.
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Optimizing household-level land shifts

- Probability household $i$ will have its land reallocated denoted $D_{ivt}$.
- $D_{ivt}$ defined as function of covariates $X_{ivt}$, conditional on $R_{vt} = 1$.
- $R_{vt}$ denotes reallocation at village-year level.

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D_{ivt} = f(X_{ivt}) \text{ if } R_{vt} = 1 \\
D_{ivt} = 0 \text{ if } R_{vt} = 0
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Identification strategy

In my paper, I use a quasi-IV strategy, exploiting the fact that households previously included in a reallocation (in the last round) are less likely to have their land reallocated in a subsequent round. Thus they have differentially greater security, compared to their neighbors in the same village and year.

What I observe is that households previously included in a reallocation, in the year of the next reallocation, invest significantly more in agricultural inputs.

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Trends in non-reallocation years

(a) Area sown

(b) Fertilizer
Trends in non-reallocation years

(c) Agricultural production

(d) Agricultural labor
The estimating equation is as follows.

\[ Y_{ivpt} = \beta_1 D_{ivpt}^{-1} \times R_{vpt} + \beta_2 D_{ivpt}^{-1} + \beta_3 X_{ivpt} + \beta_4 R_{vpt} + \nu_i + \gamma_{pt} + \sum_{i=1}^{10} F_v t + \epsilon_{ivpt} \]

The primary independent variable of interest is \( D_{ivpt}^{-1} \times R_{vpt} \): this captures the differential outcomes for households previously included in a reallocation, in the year of the next reallocation.

The other controls are the individual reallocation dummy lagged, land owned, a dummy for reallocation at the village level, and trends for villages at different levels of reallocation frequency.
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An alternate lens

- You can also consider this to be parallel to a dif-in-dif analysis: I analyze the difference in investments between households previously included in a reallocation and those not previously included, comparing across reallocation years and non-reallocation years.

- **But**, the category “previously included in a reallocation” is not fixed over time.

- If we observe multiple reallocation cycles, then in the first cycle, a household could be coded as “previously included”; in the second cycle, it might be coded as “not previously included.”
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- These households are very different from each other.
- But, they show very similar responses to tenure insecurity.
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Probability of reallocation by decile of landownership

![Graph showing probability of reallocation by decile of landownership. The x-axis represents decile of landownership, and the y-axis represents probability. Two lines are plotted: one for the probability of a positive land shock and another for the probability of a negative land shock.]
Kernel density estimates of landholding distributions

(e) Land gainers

(f) Land losers
Bias, cont.

- The hope is that even if land losers are different from households that are not included, and land gainers are also different, the only shared characteristic that gainers and losers have relative to households not previously included is differential property rights.

- You can assess the plausibility of this hypothesis, and the evidence I present that is consistent with it, when reading the paper.
Bias, cont.

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More discussion questions

- What types of investments seem to be responsive to variation in property rights, and what types are not? Are these results consistent with our intuition?
- What else could be done to verify that households who have stronger or weaker property rights are similar along other dimensions?
- What are the policy implications of these results? Can we use them to estimate the impact of endowing rural Chinese households with full property rights?
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Relationship between agriculture and other sectors

▶ We’ve seen fairly robust evidence that agriculture is not an important source of inequality: no one gets rich farming.

▶ At the same time, access to off-farm opportunities seems very important for increases in rural income – and how do individuals have capital to invest in non-agricultural opportunities?
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Broader motivation in development economics

- Evidence from a variety of contexts (not only China) suggests rural households cannot easily exit low-return forms of agricultural production and exploit higher-return opportunities.
- Are rural households trapped in agriculture (and thus in poverty)?
- While it’s challenging to answer this question directly, it is possible to indirectly test for the presence of a poverty trap by evaluating a shock that relaxes a relevant constraint.
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Paper objectives

▶ This paper exploits the evolution of an unusual grain procurement system in China to evaluate the effect of a positive lump-sum income shock on rural households.

▶ By identifying the impact of this shock on agricultural and non-agricultural investment, I seek to evaluate whether households were previously constrained by an asset-based poverty trap.

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Rice was subject to systematically larger quotas, and accordingly the income shock was larger for rice-producing areas.

I evaluate the impact of quota price fluctuations on areas more likely to produce rice because of favorable climatic conditions, compared to areas less likely to produce rice.
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- Quota quantities per household for a given village are set by county leaders: richer villages (and more agricultural villages) can expect higher quotas.
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Quota sales over time
Changing quota prices

- The quota price is set by the national government.
  - Quota prices rose rapidly after 1993 as the national government attempted to ensure grain self-sufficiency.
  - In 1995, quota price in my sample is on average 30% lower than the market price; by 2002, it is only around 2% lower.
Changing quota prices

- The quota price is set by the national government.
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Identification strategy: overview

▶ A variety of analysts have noted that the government’s grain policy was consistently harsher in its treatment of rice producers relative to wheat, maize or soybean producers.

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The interaction $Clim_{vp} \times \tilde{P}_{vpt}$ is then employed an instrument for quota income conditional on province-year and village fixed effects.

The postulated first stage can be written as follows, where $I_{ivpt}$ denotes quota income:

$$I_{ivpt} = \beta Clim_{vp} \times \tilde{P}_{vpt} + \lambda_{vp} + \nu_{pt} + Clim_{vp} \times P_{ivpt}^{sum}$$
$$+ \eta_{vp}^{clim} \times P_{ivpt}^{g} + \eta_{vp}^{ind} \times \gamma_{t} + \epsilon_{ivpt}$$
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OLS vs. 2SLS

- The ordinary least squares specifications examine the impact of higher quota income without correcting for the selection bias inherent in the selection of villages that have higher quota quantities.
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Estimating equation

The equation of interest regresses economic outcomes on lagged quota income in hundreds of yuan, with village and province-year fixed effects and the same controls included in the first stage.

\[ Y_{ivp,t} = \beta l_{ivp,t-1} + \lambda_{vp} + \nu_{pt} + \text{Clim}_{vp} \times P_{ivp}^{\text{sum}} \]
\[ + \quad \eta_{vp}^{\text{clim}} \times P_{ivp,t-1}^g + \eta_{vp}^{\text{ind}} \times \gamma_t + \epsilon_{ivp} \]

Standard errors are estimated employing two-way clustering at the province and year level.
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## Results: Summary indices

<table>
<thead>
<tr>
<th>Variable</th>
<th>Agri. prod. (1)</th>
<th>Agri. input (2)</th>
<th>Non-agri. (3)</th>
<th>Outside labor (4)</th>
<th>Migration (5)</th>
<th>Borrowing (6)</th>
<th>Grain cons. (7)</th>
<th>Other cons. (8)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quota income</td>
<td>.491 (.074)**</td>
<td>.408 (.064)**</td>
<td>.005 (.009)</td>
<td>.060 (012)**</td>
<td>-.007 (.013)</td>
<td>.005 (.034)**</td>
<td>.226 (.013)**</td>
<td>.055 (.013)**</td>
</tr>
<tr>
<td>OLS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Obs.</td>
<td>16188</td>
<td>16188</td>
<td>16188</td>
<td>16188</td>
<td>16188</td>
<td>16188</td>
<td>16188</td>
<td>16188</td>
</tr>
<tr>
<td>Quota income</td>
<td>-.916 (.358)**</td>
<td>-.970 (.313)**</td>
<td>.559 (.321)*</td>
<td>-.105 (.229)</td>
<td>.199 (.204)</td>
<td>.082 (.043)*</td>
<td>.037 (.157)</td>
<td>.217 (.089)**</td>
</tr>
<tr>
<td>Two-stage least squares</td>
<td></td>
<td></td>
<td></td>
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<td></td>
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Summarizing results

- The results show a decline in agricultural production of one standard deviation and an increase in non-agricultural investment of .4 standard deviation for each 100 yuan of quota income.
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Comparing the OLS and 2SLS results

- The differences between the two sets of estimates are generally consistent with the evidence of differential trends for high quota quantity villages.

- Households with greater quota quantities early in the period show more rapid increases in agricultural area and production, agricultural inputs, and grain consumption.

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